

A New Species of *Mexichromis* (Nudibranchia: Chromodorididae) from the Eastern Pacific

by

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Abstract. *Mexichromis amalguae* sp. nov. is described from Isla Cedros and Islas San Benito off the Pacific coast of Baja California, Mexico. Its anatomy is contrasted with known species of *Mexichromis* and with other chromodorids that exhibit similar color patterns.

INTRODUCTION

Based on a photograph, the animal described here was first reported from Isla Cedros as an unnamed species of chromodorid (Behrens, 1980). On a recent expedition to the islands west of the Baja California peninsula, two specimens of this animal were collected. This species represents the fourth known species of *Mexichromis* in the eastern Pacific. Its anatomy is described and contrasted with its congeners. Three similarly colored chromodorids in the Mediterranean are also distinguished from our new species.

CHROMODORIDIDAE

Mexichromis Bertsch, 1977

Mexichromis amalguae Gosliner & Bertsch, sp. nov.

(Figures 1-4)

Chromodorid sp.: BEHRENS, 1980:100-101, species 140 (color photograph). *Chromodoris* sp.: HAMANN, 1984 (color photograph).

Material examined: (1) Holotype, California Academy of Sciences, CASIZ 064815; collected subtidally from 13 m depth, NE side of Isla Cedros (28°10'N, 115°15'W), 19 August 1987, by Paul Solonski.

(2) Paratype, CASIZ 064816; collected subtidally, 13 m depth, W side Isla San Benito Oeste (28°05'N, 115°30'W), 17 August 1987, by Bruce Heyer.

Etymology: When Isla Cedros was "discovered" by the Spaniard Francisco de Ulloa in 1540, the island was inhabited by a tribe of Cochimi who called the island Amal-

gua, or Isle of Fogs (WHELOCK & GULICK, 1975; transliteration of the word may vary). The European conquerors misnamed the island by misidentifying its flora, and in 1732 removed the entire native American population to the Baja California mission of San Ignacio, where their culture and population were essentially eliminated by the end of the century through the "civilizing" effects of Europeanization and disease. We wish to honor a native culture and people by naming this new species based on the original name of the island. (The genus *Mexichromis* is masculine in gender; *amalguae* is genitive, meaning "of the isle of fogs," or "belonging to Amalgua.")

Description: External morphology: Total length of the living animal is about 20 mm. A cryptobranch dorid, this animal has an elongate, oval body shape. The dorsum is slightly humped and the surface smooth; the foot may protrude posteriorly past notal margin. The body coloration is blue to a light purple blue; a median longitudinal, cream white, diffuse dorsal stripe may be present (Figure 1B); some specimens (BEHRENS, 1980; HAMANN, 1984) lack this stripe entirely, whereas it was only faintly visible in the holotype (Figure 1A). This stripe begins medially behind the rhinophores and ends anterior to the gills. There is a thin yellow band encircling the entire notal margin. This band can vary from a bright yellow to a faint cream yellow color, although within a single individual its color does not vary. The rhinophores have 11-14 lamellae and are a deep navy blue color; the 7-9 unipinnate gills are also navy blue in color. The dark coloration of the rhinophores and gills is present in animals with lighter and darker colored dorsal surfaces. A whitish longitudinal stripe may be present on the posteriorly protruding upper surface

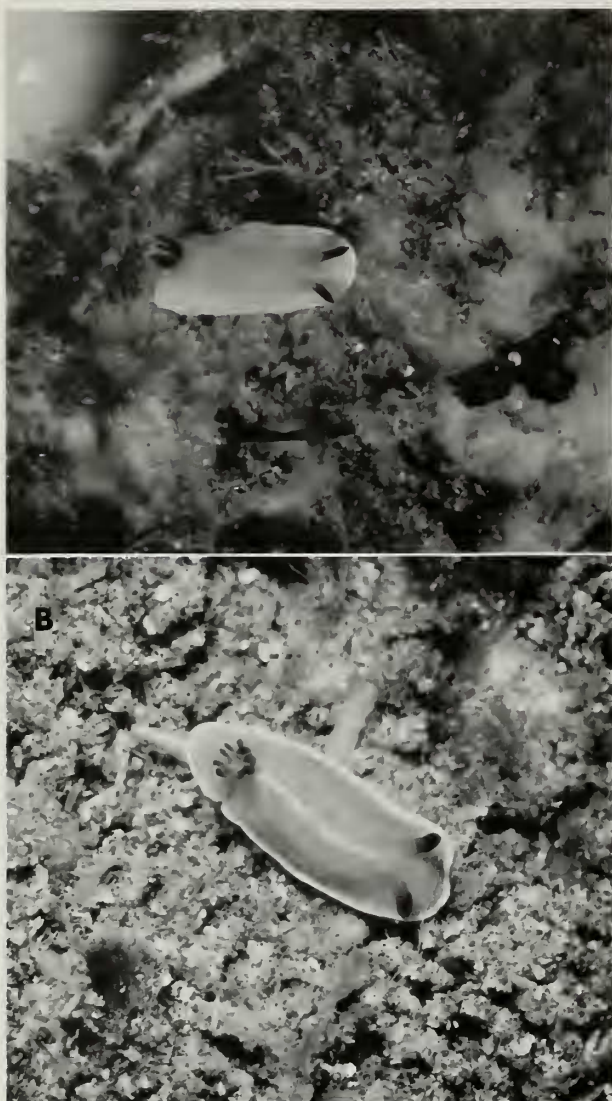


Figure 1

Mexichromis amalguae Gosliner & Bertsch, sp. nov. Dorsal views of living animals; photographs by T. M. Gosliner. A. Holotype, NE Isla Cedros. B. Paratype, Isla San Benito Oeste.

of the foot. The blue foot does not have a yellowish marginal rim.

Buccal armature: The jaws consist of numerous chitinous elements, each bearing 2 or 3 denticles (Figure 2A).

Radula: The holotype had a radular formula of $24 \times 22 \cdot 1 \cdot 22$; the paratype was $46 \times 27 \cdot 1 \cdot 27$. Both specimens had a small, thin, very low elongate rachidian. The first lateral tooth (Figures 2B–D) had 1–3 inner denticles and 3 or 4 outer denticles on each side of the central cusp. Succeeding laterals had deeply indented denticles on the posterior side of the cusp. The innermost lateral teeth appeared nearly bicuspid because of the deep cleft between

the cusp and the first denticle; the length of the lower denticles was about $\frac{1}{3}$ the total width of cusp (along the anterior-posterior axis, measuring from the front of the cusp to the tip of the denticle). The primary cusp of the middle (Figures 3A, B) and outer (Figures 3C, D) laterals shortens, so that succeeding denticles are longer. This is the strikingly “acuspitate” or “pectinate” condition described by BERTSCH (1977) and RUDMAN (1984) for the genus *Mexichromis*. There are 4–7 prominent denticles on the posterior surface of the laterals (Figures 3A–D). The outermost laterals become shorter and have a wider anterior-posterior axis to the cusp, nearly losing the distinct basal flange that protrudes past the cusp.

Reproductive system: The arrangement of reproductive organs is triaular (Figure 4). The straight, saccate ampulla narrows distally from the ovotestes, and bifurcates into the short oviduct and elongate vas deferens. The proximal portion of the vas deferens is thin, prostatic, and highly convoluted. More distally it becomes muscular, forming the ejaculatory segment. The distal end of the vas deferens expands and enters the wide muscular penial sac. The oviduct is short and enters the female gland mass below the bursa copulatrix. The bursa is thin-walled and joins the muscular, recurved receptaculum seminis. Just distal to the junction of the bursa and the receptaculum is the thin, slightly convoluted uterine duct, which enters the female gland mass. A large, ramified vestibular gland is present in the paratype specimen. The holotype is less mature and has a much smaller, but structurally identical vestibular gland.

Distribution: This species has only been found on the Pacific offshore islands of central Baja California: Isla Cedros and Islas San Benito. All known records are subtidal, between 13 and 23 m deep (deepest record in HAMANN, 1984).

Discussion: *Mexichromis amalguae* is clearly placed in the genus *Mexichromis* based on its acuspitate radular teeth and a prominent vestibular gland (BERTSCH, 1977; RUDMAN, 1984). *Mexichromis amalguae* represents the fourth species in the genus reported from the Pacific coast of North America. It most closely resembles *M. porterae* (Cockerell, 1901), but differs significantly in several aspects of its external and internal morphology. Both have a uniform bluish coloration with white or yellow longitudinal lines; however, *M. porterae* has a thin longitudinal mid-dorsal white line flanked by two mid-lateral yellow lines; the margin is rimmed with white. Although *M. amalguae* may have a single medial longitudinal cream line, no yellow mid-lateral lines extending lengthwise along the body from the rhinophores to the gills are present. It possesses a yellow rather than white marginal band.

The radular teeth also differ significantly between *Mexichromis amalguae* and *M. porterae* (Figures 5A–C). A row of vestigial rachidian teeth is present in *M. amalguae* but is entirely wanting in *M. porterae* (Figure 5A) and all other described members of the genus. The innermost lat-



Figure 2

Mexichromis amalguae sp. nov. Scanning electron micrographs. A. Jaw elements. B, C. Central region of radula of holotype from different angles, showing vestigial rachidian and inner lateral teeth. D. Central region of radula of paratype.



Figure 3

Mexichromis amalguae sp. nov. Scanning electron micrographs of radular teeth. A. Middle of half-row of holotype. B. Middle of half-row of paratype. C. Outermost lateral teeth of holotype. D. Outermost lateral teeth of paratype.

eral of *M. amalguae* bears a series of smaller denticles on either side of a larger central denticle, as in *M. tura* (Marcus & Marcus, 1967) (MARCUS & MARCUS, 1967:fig. 61; RUDMAN, 1984:figs. 70A, B). In *M. porterae* (Figure 5A; BERTSCH, 1978:figs. 55, 56; RUDMAN, 1984:fig. 72A) the innermost lateral teeth are laterally flattened.

The most profound difference between the two species is in the anatomy of the reproductive system. In *Mexichromis amalguae* the receptaculum seminis is almost as large as the bursa copulatrix, while in *M. porterae* the receptaculum is much smaller (RUDMAN, 1984:fig. 71a; present study), as in the genus *Hypselodoris* (RUDMAN, 1984).

Mexichromis antonii (Bertsch, 1976) is immediately distinguished by its complex coloration pattern of blue, magenta, black, yellow-orange, and white; by the larger number of rows of teeth (up to 78 reported), and by the longer and greater number of denticles on each tooth (cf. BERTSCH, 1976b:figs. 5–8).

Mexichromis tura (Marcus & Marcus, 1967) has a complex series of three differently colored marginal bands and a dark dorsal center spotted with yellow dashes and dots (KERSTITCH & BERTSCH, 1988). Its proportional radular count is slightly different (42 rows, 31 teeth, versus the 24–46 rows and 22–27 teeth of *M. amalguae*). More importantly, its teeth are shaped differently (cf. RUDMAN, 1984:fig. 70; BERTSCH, 1978:figs. 57–60).

Indo-Pacific species have entirely different color patterns and radular characteristics. *Mexichromis mariei* (Crosse, 1872) is white with orange and purple spots; the innermost lateral teeth have more denticles (5–7) than do similar teeth in *M. amalguae* (cf. RUDMAN, 1983:fig. 22). *Mexichromis festiva* (Angas, 1864) is white with red, orange, or reddish purple spots and marks; its teeth have fewer and longer denticles than does *M. amalguae* (cf. RUDMAN, 1983:fig. 23). *Mexichromis macropus* Rudman, 1983, is white with purple spots on raised tubercles with bright orange streaks around the notal rim; its radula has more rows (80–82) than does *M. amalguae* and the denticles on teeth from the middle of each half row are smaller (cf. RUDMAN, 1983:fig. 25) than those of *M. amalguae*.

RUDMAN (1984) suggested that three other species may belong to the genus *Mexichromis*: an animal from Ghana reported by EDMUNDS, 1981 (discussed separately below), *Glossodoris multituberculata* Baba, 1953, and *Chromodoris kempfi* Marcus, 1971. The latter two species are immediately distinguished from *M. amalguae* by, respectively, a chrome-yellow body color with purple-tipped dorsal tubercles, and by the yellow-and-black-square design. The radular counts are also proportionately quite different: *G. multituberculata* has a count of 65 (30·0–30), whereas *C. kempfi* has 60 (105·0–105) (see BERTSCH, 1976a, for a discussion of the taxonomic use of radular counts).

There are several species of chromodorids occurring in the Caribbean and Mediterranean seas that have similar coloration to *Mexichromis amalguae* and need critical comparison. They are clearly not conspecific (not even con-

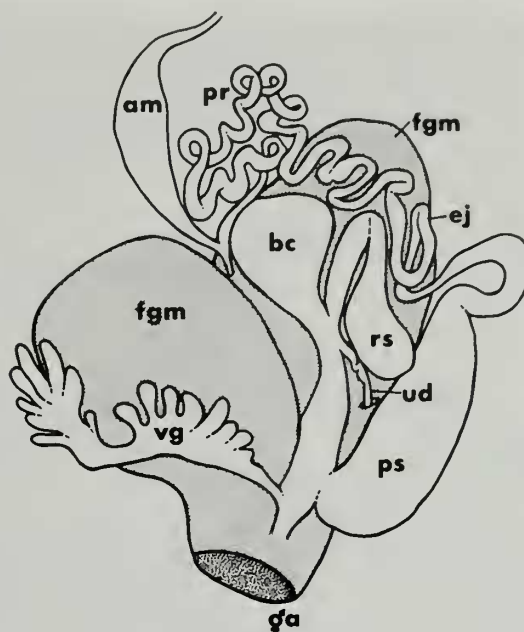


Figure 4

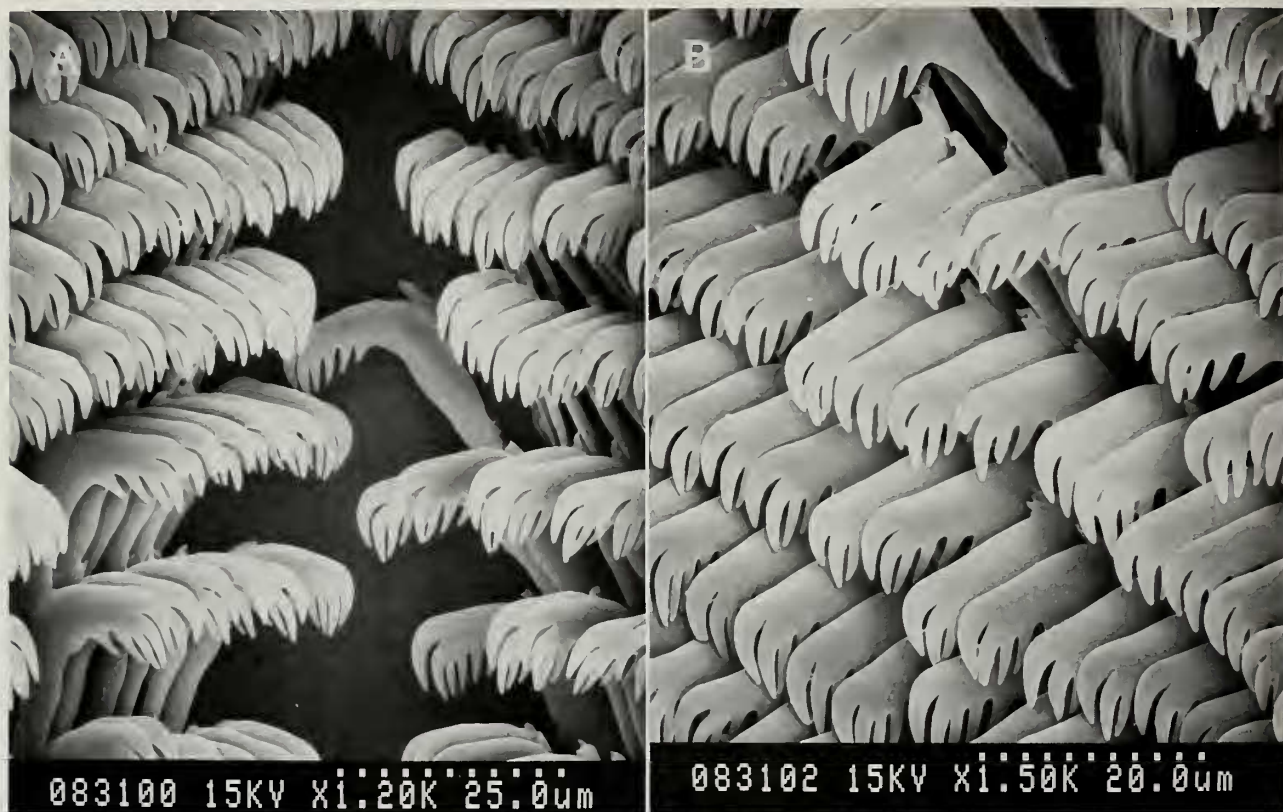
Mexichromis amalguae sp. nov. Reproductive system. ♂a, male-female atrium (common genital aperture); am, ampulla; bc, bursa copulatrix; ej, ejaculatory portion of vas deferens; fgm, female gland mass; pr, prostatic portion of vas deferens; ps, penial sac; rs, receptaculum seminis; ud, uterine duct; vg, vestibular gland.

generic), but the distinguishing characters must be viewed carefully.

Chromodoris nyalya Marcus & Marcus, 1967 (which may well be a species of *Noumea* Risbec, 1928), reported from the Florida Keys, has a brilliant blue body color, but the notum is margined with a bright red band. The radula is also significantly different in the shape of the teeth, the absence of a rachidian, and the radular formula (60 rows of teeth with 27 teeth in each half row; *Mexichromis amalguae* has only 46 rows with 27 teeth per half row).

Chromodoris purpurea (Laurillard, 1831) has a light pink body color, with dark pink, white-tipped gills and rhinophores. The notum is a plain pink, edged with orange (SCHMEKEL & PORTMANN, 1982:61). The tonal variation of pink–purple makes it necessary to compare *C. purpurea* with our eastern Pacific new species. The tonal differences are pinkish and orange versus light blue and cream yellow. The radula count of 36 rows and 25 teeth per half row is within the range of our new species, but *C. purpurea* lacks a rachidian. The tooth shapes are very different: each tooth has a *Chromodoris* cusp with 7–9 sharp, small denticles on the posterior surface of the cusp (SCHMEKEL & PORTMANN, 1982:364–365; pl. 19, fig. 5).

Chromodoris krohni (Verany, 1846) has been variously described as pink or blue, with yellow or white lines. SCHMEKEL & PORTMANN (1982:58) described a light pink



body, dark purple gills and rhinophores, and mantle edged with yellow; there was a longitudinal yellow stripe down the middle of the back, with another (often broken) yellow line on each side between the rhinophores and gills; there may or may not be a yellow or white dorso-median line on the foot. IHERING (1880:89) emphasized a different tonal quality in the coloration: dorsum blue or rose ("caeruleuscenti vel roseo"), with three white lines down the back; golden marginal band; rhinophores purple, the five gills purple with white tips. The most obvious external difference is that *Mexichromis amalguae* may have only one dorsal longitudinal line. The radula is distinctly different, lacking a rachidian, despite the similarity of rows and tooth counts (SCHMEKEL & PORTMANN, 1982:58, cite 44 rows, 23 teeth per half row in a 10-mm-long animal; and IHERING, 1880:91, cites 30 rows, 8–10 teeth per half row in a 6-mm-long animal). Moreover, the teeth are very different from *M. amalguae*: they are distinctly *Chromodoris*-shaped, with a small cusp and up to six denticles; they lack the large, comblike denticles and the deep notch between the cusp and first denticle seen in the teeth of *M. amalguae* (cf. the illustrations by SCHMEKEL & PORTMANN, 1982: 364–365, pl. 19, fig. 3; and that by IHERING, 1880:pl. II, fig. 11).

Hypselodoris tricolor (Cantraine, 1835) is another bluish animal with a yellow or orange marginal band and longitudinal stripe. Published descriptions of this species emphasize tonal variations. SCHMEKEL & PORTMANN (1982: 67) describe a dark blue body color, with the notum edged in orange (becoming yellow or white in front of the rhinophores and behind the gills). An opaque white or yellow longitudinal line begins in front of the rhinophores and extends posteriorly, encircling the gills. There is an additional lateral line of white or yellow on each side of the medial line; it may be broken and not continuous. Rhinophores and gills are dark blue (with or without white markings). Ihering conceded that *Chromodoris tricolor* and *C. gracilis* Delle Chiaje, 1822, were similar species, but maintained them separate, identifying *C. tricolor* as having only a median longitudinal yellow line, whereas *C. gracilis* had three longitudinal yellow lines. SCHMEKEL & PORTMANN (1982) and we consider them synonymous and the characteristics to be merely intraspecific variation.

The radula of *Hypselodoris tricolor* is very different from that of *Mexichromis amalguae*. Radular counts are 44 (44·0·44) (SCHMEKEL & PORTMANN, 1982:67) and 36 (35·0·35) (IHERING, 1880:65, 70), proportionately very different from *M. amalguae*; it also lacks the rachidian. The shapes of the teeth are immediately distinguishable, being typically those of *Hypselodoris*, strongly bicuspid, with 3–6

small, sharp denticles on the posterior surface (not the greatly elongate denticles of *M. amalguae*). The illustrations of IHERING (1880:pl. II, figs. 1, 2) and SCHMEKEL & PORTMANN (1982:364–365; pl. 19, fig. 7) of *H. tricolor* contrast with our scanning electron micrographs of *M. amalguae*.

EDMUNDS (1981:195–199) identified five specimens collected in Ghana as *Mexichromis tricolor*. He was probably correct in assigning these animals to *Mexichromis* (the radula has the strong, comblike denticles characteristic of *Mexichromis*), but erroneous in assigning it to the species *Hypselodoris tricolor*. There are some subtle coloration differences, but most importantly, the radula is quite different (at the genus level) from *H. tricolor*: tooth shapes do not match, nor does the radular count of 23 (12·0·12). EDMUNDS' (1981) specimens may represent another, yet undescribed species of *Mexichromis*. Regardless, its coloration is different from that seen in *Mexichromis amalguae* (black band inside the yellow marginal band, and white longitudinal mid-dorsal line begins in front of the rhinophores), and the radula is different.

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LITERATURE CITED

- ANGAS, G. F. 1864. Description d'espèces nouvelles appartenant à plusieurs genres de mollusques nudibranches des environs de Port-Jackson (Nouvelle-Galles du Sud), accompagnée de dessins faits d'après nature. Jour. Conchyl. (3)12: 43–70.
- BABA, K. 1953. Three new species and two new records of the genus *Glossodoris* from Japan. Publ. Seto Mar. Biol. Lab. 3:205–211.
- BEHRENS, D. W. 1980. Pacific coast nudibranchs. Sea Challengers: Los Osos, California. 112 pp.
- BERTSCH, H. 1976a. Intraspecific and ontogenetic radular variation in opisthobranch systematics (Mollusca: Gastropoda). Syst. Zool. 25(2):117–122.
- BERTSCH, H. 1976b. A new species of *Chromodoris* (Opistho-

Figure 5

Mexichromis porterae (Cockerell, 1901). Scanning electron micrographs of radula of specimen from Isla San Benito Oeste. A. Central region. B. Middle of radula. C. Outermost lateral teeth.

- branchia: Nudibranchia) from tropical west America. Veliger 19(2):156-158.
- BERTSCH, H. 1977. The Chromodoridinae nudibranchs from the Pacific coast of America. Part I. Investigative methods and supraspecific taxonomy. Veliger 20(2):107-118.
- BERTSCH, H. 1978. The Chromodoridinae nudibranchs from the Pacific coast of America. Part III. The genera *Chromolaichma* and *Mexichromis*. Veliger 21(1):70-86.
- CANTRAINE, F. J. 1835. Mollusques—"diagnoses ou descriptions succinctes de quelques espèces nouvelles de mollusques." Bull. Acad. Roy. Sci. Bruxelles 2(10):380-401.
- COCKERELL, T. D. A. 1901. Pigments of nudibranchiate Mollusca. Nature 65(1674):79-80.
- CROSSE, J. C. H. 1872. Diagnoses molluscorum Novae Caledoniae incolarum. Jour. Conchyl. (3)20:69-74.
- DELLE CHIAJE, S. 1822. Atlas. Memorie sulla storia e notomia degli animali senza vertebre del regno di Napoli. 69 pp.
- EDMUNDS, M. 1981. Opisthobranchiate Mollusca from Ghana: Chromodorididae. Zool. Jour. Linn. Soc. 72:175-201.
- HAMANN, J. 1984. Cover photograph. Shells and Sea Life 16(9).
- IHERING, H. VON. 1880. Beiträge zur Kenntniss der Nudibranchien des Mittelmeeres. 1. Malak. Blatt. N.F. 2:57-112.
- KERSTITCH, A. & H. BERTSCH. 1988. *Mexichromis tura*: range extension of a rarely observed nudibranch. Veliger 30(4):421.
- LAURILLARD, C. L. 1831. In: Guérin Mag. de Zool. 1:17, pl. 17.
- MARCUS, EV. DU BOIS REYMOND. 1971. Opisthobranchs from northern Brazil. Bull. Mar. Sci. 20(4):922-951.
- MARCUS, EV. DU BOIS REYMOND & ER. MARCUS. 1967. American opisthobranch mollusks. Univ. Miami Stud. Trop. Oceanog. 6:256 pp.
- RISBEC, J. 1928. Contribution à l'étude des nudibranches Néo-Calédoniens. Faune Colon. Française 2(1):1-328.
- RUDMAN, W. B. 1983. The Chromodorididae (Opisthobranchia: Mollusca) of the Indo-West Pacific: *Chromodoris splendida*, *C. aspersa* and *Hypselodoris placida* colour groups. Zool. Jour. Linn. Soc. 78:105-173.
- RUDMAN, W. B. 1984. The Chromodorididae (Opisthobranchia: Mollusca) of the Indo-West Pacific: a review of the genera. Zool. Jour. Linn. Soc. 81:115-273.
- SCHMEKEL, L. & A. PORTMANN. 1982. Opisthobranchia des Mittelmeeres. Nudibranchia und Saccoglossa. Springer-Verlag: Berlin. 410 pp.
- VERANY, G. B. 1846. Descrizione di Genova e del Genovesato. 1(2). Regno Animale Molluschi. Pp. 90-110.
- WHELOCK, W. & H. E. GULICK. 1975. Baja California guidebook. Arthur H. Clark: Glendale, California. 232 pp.